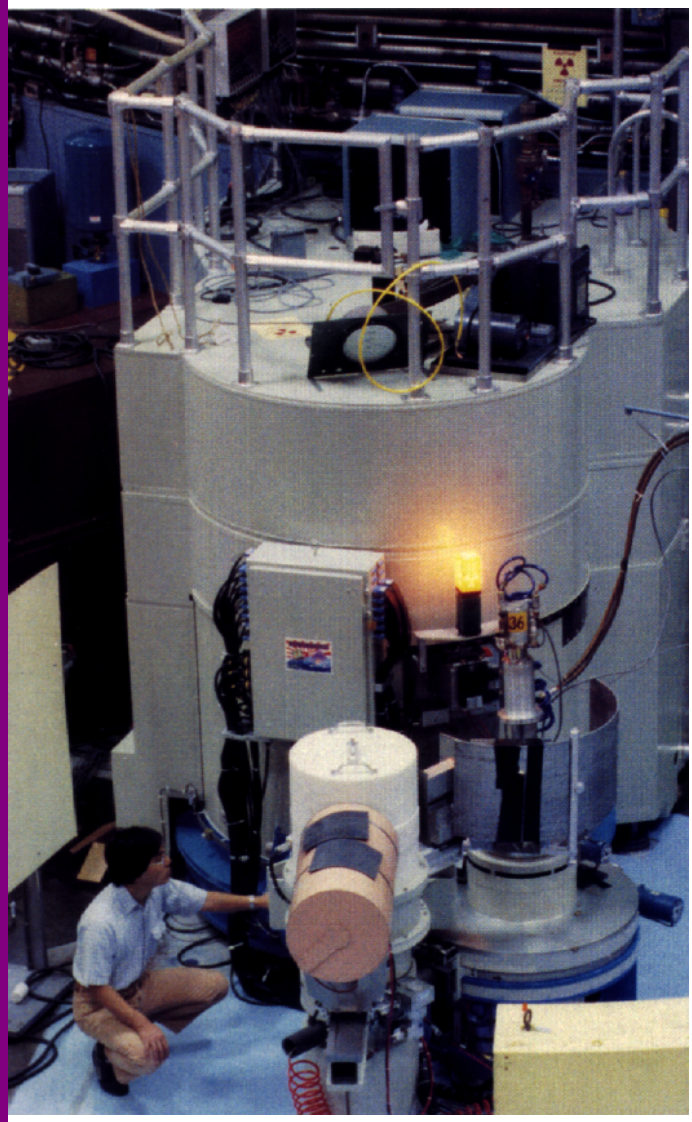
# HFBR



**Institute for Solid State Physics, University of Tokyo, prepares an experiment to determine the structure of a new magnetic material. Neutron structure determinations have resulted in an improved understanding of magnetism and led to the development of new and better magnets.**

The High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory supports a range of neutron-based research in solid-state and nuclear physics, chemistry, and structural biology. The Reactor's nine beam tubes deliver neutrons to 15 experimental facilities used by about 250 researchers each year.

The HFBR is equipped with an operating liquid-hydrogen moderator supporting a major program of subthermal neutron investigations. Subthermal neutrons have low energies and are well-suited to determining spatial relationships between atoms in large molecules, such as proteins, viruses, and polymers. Another important capability is the production of polarized neutrons – those that spin in the same direction – which are sensitive probes of magnetic properties of materials.

Studies of crystal vibrations and magnetic fluctuations at near room temperature are performed on HFBR's triple-axis spectrometers. The protein crystallography station allows complete freedom in rotating and orienting crystals under study and provides optimal data on atomic positions in large unit crystals – a material's smallest possible repeating unit.

Two unique small-angle neutron-scattering instruments allow structural study of intermediate-sized molecules, A neutron reflectometer explores the structural properties of surfaces. A high-resolution powder diffractometer allows structural studies of complex polycrystalline materials such as catalysts and advanced ceramic and electronic materials.

Nuclear physics research at HFBR ranges from studies of nuclear reactions, in which atomic nuclei capture incoming neutrons, to studies of gamma radiation emitted from excited nuclei. The major Positron Physics Facility supports studies of the atomic order and electronic characteristics of metal and semiconductor surfaces.

Seven "vertical thimbles" allow material samples to be placed in the Reactor core for direct irradiation at a variety of neutron energies for structural and analytical purposes.

# HIGH FLUX BEAM REACTOR

## MAJOR USERS

- Brandeis University
- Columbia University
- E.I. du Pont de Nemours & Company
- Exxon
- Genentech
- General Motors
- IBM
- Iowa State University
- Lucent Technologies
- Massachusetts Institute of Technology
- SUNY, Stony Brook
- University of Connecticut
- University of Pennsylvania

## ACCOMPLISHMENTS

General Motors scientists used HFBR to understand the structure and behavior of high performance magnets for electric motors.

Industrial scientists use HFBR to probe the structure and function of zeolites, important catalysts in petroleum cracking and refining, and to develop detergents for use as oil additives.

The use of neutron diffraction techniques to study protein structure and function – routinely used today by industrial, academic, and government researchers – was pioneered by experiments at HFBR.

Brookhaven scientists collaborated with university and industrial scientists to study correlations between atoms, and to help unravel the mysteries of high-temperature superconductivity.

Scientists from Brookhaven, Iowa State, and Clark University performed the first detailed studies of the lifetime and decay of zinc-80, a key to understanding how elements are produced in exploding stars.

## HFBR USERS

U.S. Universities

U.S. Government Labs

Foreign Labs

U.S. Industry

**A skeletal model of myoglobin, a protein involved in the respiration of oxygen in the lungs. The data, taken at the HFBR, allowed for the first time the accurate determination of weakly bound surface water molecules.**